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Abstract

BURN UP PHYSICS

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The present communication is devoted to a body of theoretical and experimental work carried out at the C.E.A. with the aim of adding to the current knowledge on the evolution of the reactivity (during fuel irradiation) in natural or slightly enriched Uranium reactors.

The difficulties of performing direct experiments on large amounts of irradiated fuels are reviewed - especially in operating power reactors - and the necessity is underlined for fundamental research in two directions :

on one hand, the change in the composition of the fuels (chains of heavy nuclei, fission products),

and on the other hand the effect of changes in composition on the neutron balance.

Before presenting three types of experiments which have been carried out, the importance of the problems associated with the neutron spectra is stressed and the practical methods used for the calculations are briefly described.

The systematic irradiation of several types of fuel, followed by their chemical and isotopic analysis has been going on for several years. An outline

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of the experimental programme is given with a description of the methods employed : α, β, γ chain for the preparation of samples determination of the plutonium content by coulometry and double isotopic dilution, separation of Boron used in some cases for the measurement of integrated neutron densities. The interpretation of the measurements is discussed with some examples.

A second and more recent series of experiments deals with the investigation of lattices, using "synthetic" fuels (Uranium-Plutonium alloys) as compared to slightly depleted or enriched Uranium. Various experiments are considered on heavy water and on cold graphite, then on graphite heated up to 500°C. Some results already obtained are listed. These experiments, requiring nearly a metric ton of each type of fuel cannot be pursued in a systematic manner. This is why is developed since several years a method of differential measurement by oscillation, which requires samples of the order of several kilogrammes only. The relationships between these measurements and the investigations of lattices are discussed, and an outline is given of the way of carrying out the systematic study of fuels of various compositions. The method has been successfully applied to the systematic study of irradiated fuels (analysed independently by the methods mentioned above) thus giving the possibility of measuring "in situ" the absorption of fission products.